

ABSTRACT

This Final Project discusses the design and implementation of an orientation monitoring and waste detection system on a mobile robot based on a combination of the FPGA DE0-Nano and a microcontroller. The system utilizes the MPU6050 sensor to measure acceleration (accelerometer) and angular velocity (gyroscope) along three axes (X, Y, Z). In its default configuration, the accelerometer produces raw 16-bit values that are converted into acceleration units, while the gyroscope has a measurement range from $-250^{\circ}/s$ to $+250^{\circ}/s$ with a certain sensitivity level. These raw output values are processed into physical units for real-time orientation angle calculations. Although the FPGA DE0-Nano is already equipped with an internal accelerometer, technical limitations led to the use of the MPU6050 as an alternative. In addition, the system is equipped with an ultrasonic sensor to detect the presence of waste within a certain distance threshold, allowing the robot to respond quickly to nearby objects. Data communication is carried out via UART with internal FPGA clock synchronization. The experimental results show that the system is capable of accurately reading orientation data and providing early indications of waste at critical distances.

Keywords: Obstacle Avoidance Sensor, Ultrasonic, FPGA DE0-Nano, ESP32, UART, Serial Monitor, MPU6050, WiFi, Ground Control Station